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ABSTRACT

A human systems approach that emphasizes knowing the parts of a phenomenon, their order, and particularly their interactions needs to be adopted by industrial arts. A student-based theoretical framework that incorporates systems and subsystems in industrial arts has been presented by Donald Maley. The theoretical base includes 10 organismic propositions and delineates how the whole boy or girl can best be served in industrial arts. Its major components are the sensory system, the physical motor, the psychological, emotional, intellectual, personality factors, developmental tasks, and coordination of the mental, biological, and intellectual units of the person. The psychomotor function involvement has been focused on as being especially important. Research is needed to study the relationship between the psychomotor and emotional systems, because worker boredom has been observed as one determinant of low-quality work. Studies have already shown significant changes in affective, psychomotor, and cognitive behavior of students after creative thinking experiences. A theoretical model that emphasizes the linking of the sensory, psychomotor, personally emotional, and intellectual systems of students is in the direction of what industry identifies as a critical need. (YLB)

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AN ACTIVITY AND THEORY FOR APPLYING HUMAN SYSTEMS APPROACH TO INDUSTRIAL ARTS

Walter S. Mietus

The French have been teaching engineering by the systems approach since 1970, in the United States interest began in 1968 and today it is enthusiastically embraced by industry, business, management and selected universities (Hicks, 1977, p. 194). In Industrial Arts, the terms systems analysis and systems approach appear generally in a way to suggest the possibilities and implications for the profession. This paper was designed to help the profession make an incremental movement in the systems approach direction.

M. F. Bensen in his writings in the American Council on Industrial Arts Teacher Education Yearbook 1980 states that we are in "serious trouble because we do not keep up with the state of the art of technology." He further calls for the systems approach when he writes.

> It is apparent that much of what we are teaching as current content is in reality a historical approach. We are teaching hand crafted furniture making, cabinetry and cedar chests to the youth of America under the guise that this is the way it is done. Many of us, when we are questioned about learning all the parts of the hand plane, tend to hide behind the smoke screen that it is one of the basics. However, when one looks ahead to a life in a technological society, (and assuming that industrial arts is a part of general education) then it is readily apparent that we will be using a microprocessor (hand calculator, etc.) much more frequently than we will a hand plane as an everyday function.
>
> Hence, we must realize that systems are as important as the tools and the resources of technology, and that the systems be integrated into our instruction and viewed by the learner as the powerful element that it is. (Benson, 1980, p. 337)

This is not to suggest that the content we now use should be discarded, it should be put into a new order of priorities and interface with current elements technology. It does suggest that the focus of what is being emphasized

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should be changed and designed to include what are current needs in technology and society.

Purpose---This paper was designed to:

1. Clarify and stimulate interest in the concept of the human systems approach.
2. Present a theoretical framework (by Dr. Donald Maley, 1980) that incorporates systems and subsystems in Industrial Arts.
3. Suggest an activity for teachers to move in the direction of implementing an idea which was stimulated by the theoretical framework and a need in industry.

Literature in varied disciplines use terms such as psycho-social systems, neuro-biological systems, socio-economic systems, industrial technology systems, etc. In his article the "Systems Approach" (Chinal, 1985) in a general sense defines the concept. He indicated that "a system is a set of elements organized as a whole so as to fulfill one or several objectives and thus subjected to various interactions." It is a way of thinking and attitude when studying a phenomena which in the end convincingly shows that the whole is more than the sum of the parts. It emphasizes knowing the parts, their order and particularly their interactions. This applies to the phenomena of man, society, and technology.

Taking an example from the work of HICKS, Introduction to Industrial Engineering, 1977, a further clarification can be provided.

> Modern aircraft or satellite launchers are systems. For example a supersonic aircraft is basically, comprised of structure (fuselage, wings, etc.) turbojet engines, hydraulic systems, and avionics. Avionics itself may include autopilot, air data, computer, inertial guidance systems, doppler radar, frontal radar, map display, airborne digital computer, input output unit, etc. All these pieces of avionics equipment are electrically interconnected and together make up larger subsystems such as navigation systems, flight control systems, etc. Their various physical interconnections actually materialize the functional interdependence of the component "black boxes."

> For example the Mach number computed by the air data computer is not only displayed to the pilot, but also simultaneously fed to the autopilot, to the air intake mechanism and to the central digital computer. Similarly, the attitude (yaw, pitch, roll) delivered by the inertial guidance unit is used as a reference for the radar, doppler, the central computer and the autopilot. On a modern aircraft, dozens of interconnections and interactions are evident. Elements, subsystems, systems, and their interactions appear in a technical sense and will determine problems in design and development of the whole system. Systems require a combined application of several or possibly many different technologies.

An endless list of analogies relating to Industrial Arts can be made with the above technical example. Analogies interfacing with the structure and function of man, society, and technology can be converted to significant questions such as, What sensory input needs to be provided to interface with the development of fine motor skills? How do personal emotional feelings effect fine motor skills. Which affective factors promote accuracy, dexterity, quality of completed tasks? What tasks enhance the intellectual function of perception? How do the elements of sensory, personal emotional, and intellectual interface with the needs of society? These and other questions you may have are indeed idealistic and complex. Because they are, we need a theoretical framework to serve as a guide to systematically and empirically generate data that will give Industrial Arts credibility in society. It does not mean we will be doing the same things; it does mean that with a theoretical framework we can all generate a body of knowledge that fits into a unified whole.

Industrial Arts does have several theoretical frameworks to follow. These are industry or technology based. A most recent one is student based. In his recent publication "Industrial Arts Puts the Whole Boy and Girl in the School in 1980," Dr. D. Maley (1980) presents a clear framework to implement the systems approach. It is comprehensive and sound. It has stimulated serious

educators to redesign their programs and experiment with new strategies. He also is implementing the theory by formulating new curriculum designs intergrating systems of the Individual, Society, Industrial Arts content and appropriate teaching strategies.

The theoretical base includes ten organismic propositions and it delineates how the whole boy or girl can be best served in Industrial Arts. It includes the major components of; the sensory system, the physical motor, the psychological emotional, intellectual, personality factors, developmental tasks, coordination of the mental biological and intellectual units of the person. This schema invites holistic research and research via reductionism. One will complement the other. It abounds in ideas for curriculum development and methodology. This article focuses on one sub-system of the theoretical framework, i.e., the Psychomotor Function Involvement (Maley, 1930, p. 18).

Categorized under the sub-system Psychomotor Function are the elements of fine and large muscle coordination which are required for use when a teacher requires kinesthetic performance from his/her students. In reference to this component of the framework he states:

> As one examines the role of Industrial Arts in this broad arena of action learning in association with the kinesthetic, we must go beyond the issue of fine or large muscle control coordination. The end sensory organs located in muscles, joints, and tendons that are activated by physical movement or contact with other elements are a part of a system. Not only is there manipulative and coordinative capability there is the sensory communication process which serves as a prime source of enrichment (Maley, 1980, p. 8).

He lists a number of items for kinesthetic involvement that may provide communication to the mind by experiences such as, the level of coordination of muscles, ease or difficulty of manipulation, texture and feel of materials acting on one another, etc. Along with these sense experiences he emphasizes

the quality and accuracy of perception.

Other major synthesizing frameworks and models which delineated psychomotor skill tasks were developed by J. M. Shemick in 1977, and D. R. Herschbach in 1975. Shemick's scholarly work is an extension of research done by himself and the leading authorities on the subject. He presented a model with a hierarchy of three levels: 1) cognitive motor skills; 2) language and perceptual motor skills; and 3) sensory dependent skills including the input of perception. The research completed by D. R. Herschbach (1975) emerges with a very useful product or instrumentation for writing performance objectives for the psychomotor domain. It is a clearly defined and a powerful tool for writing performance objectives. The above models do not elaborate on the interaction of emotional (affective) states as they may affect performance.

At this point the practitioner may feel the question, What makes the sensory the manipulative and the coordinative skills important today? Where does society possibly need these attributes?

Marvin Harris (1981), an anthropologist for thirty years points out the drop in the quality of American products services and quality of life. He stated:

> America has become a land plagued with loose wires, missing screws, things that don't fit, don't last and don't work. Push the handle on the pop-up toaster and it won't stay down. Or it will stay down and burn the toast. Faulty thermostats plague hairdryers and coffee makers. Electric fans used to work forever; now, the plastic blades develop cracks and have to be replaced. Vacuum cleaners have plastic handles that wobble and break; their cords come loose from the switch; their motors burn out..... Dissatisfaction runs wider and deeper than experts suspected. Of the people responding to the pollsters' questions, 59 percent said they had returned one or more unsatisfactory products to the place of purchase during the preceding 12 months. A year later, the figure rose to 70 percent.

As long as consumers tolerate shoddy goods management will not change its policies. Systems engineering can solve the problem but the consumer must make management change its attitudes.

Peter Behr(1981) reports that, Chrysler Chairman Lee A. Iacocca contends that "the Japanese automakers aren't the superbeings they're made out to be, but they have an edge in quality. Their designs are no better than ours, but when their workers get to putting the 15,000 parts together, they just do it nicely and we don't. We were sloppy."

Cultural tradition of the Japanese includes a deep value for creative activities. Many companies allow brief periods of time during working hours for the individual to digress from rather monotonous jobs to engage in a creative experience. While some companies do not allow time, invariably the cultural value finds expression through some medium after working hours. The medium can be artistic or industrial arts or scholarly types. That creative expression tends to make happier students and improve psychomotor skills in Industrial Arts has been dramatically observed in the research by Mietus (1968). The fact that millions of American factory workers have boring jobs makes a strong case for industrial arts to help people experience creative activities for purposes of avocational pursuits.

Automatic and robonic machines working to sloppy tolerances and workers who assemble parts with a low degree of dexterity contribute to the American problem. The need for revitalizing the goals of accuracy, dexterity and precision as it interfaces with human systems needs to be studied.

Appended to this article is an instrument for use by any reader. While it was used for research by the writer it was also used as a teaching device to enable students to discover some of the more profound connections between

the psychomotor and emotional systems. An example is provided.

For purposes of study, four industrial arts students were given the test. (See the instructions on cover sheet.) A video tape recorder was set up to make a visual record as to how each person used his/her fine motor and large motor activated extremities during the process. On replay and analyses many differences between persons were dramatically observed.

A seminar session including the visual recording generated many insightful facts of human psychomotor activities by discovery. Prior to taking part in the test the students were asked to fill out a questionnaire inquiring as to their emotional feelings in terms of; fear, anxiety, confidence, indifference, emotional tone,feelings of being imposed upon and feelings of gladness to participate. They were also instructed to maintain a conscious awareness of their feelings, and mental processes during the test. The discussions that followed brought out the idea that feelings were a function of psychomotor performance. Students discussed the ideas that perception, will and perseverance were the basic elements to the function of the psychomotor systems. These thoughts came from discovery on the part of the students rather than a study of a psychology text.

The practitioner, i.e., the Industrial Arts teacher is encouranged to use the psychomotor test provided. He or she will not be departing from what industry does. For example Peter Behr 1981) in his article "A Search for Quality" describes the following scenario at a Cadillac plant in Detroit.

> A score of rank and file auto workers in an air-conditioned conference room are writing down all the uses they can think of for a nail, a coat hanger and an ashtray, enjoying and applauding each other's efforts. A company psychologist and a one time radical union leader are running this exercise in group dynamics which is a part of an attempt by the United Auto Workers and General Motors Corp. to change the way auto workers feel about their jobs, their fellow workers and themselves.

Experiences and creative exercises which were more intensive than the above were used in Industrial Arts are described in the research by Mietus (1966). This study based on data from four hundred high school students showed significant changes in affective, psychomotor, and cognitive behavior after creative thinking experiences.

Human engineering in industry is slowly changing its emphasis in the direction of meeting the psychological needs of the individual worker to achieve a degree of quality in his or her work life. Humanizing work means to look at the person as an integrated series of complex subsystems. The contrast is between the narrow interest of production of goods and services and the broader effort of relating to the "person incorporated concept". Accordingly, the theoretical model which emphasizes the linking of the sensory, psychomotor, personal emotional and intellectual systems of the student is clearly in the direction of what industry identifies as a critical need. The prescription of working with the exercise provided in this report should be taken as an example of the powerful potential Industrial Arts has to contribute to solving the problems of man, society and technology.

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